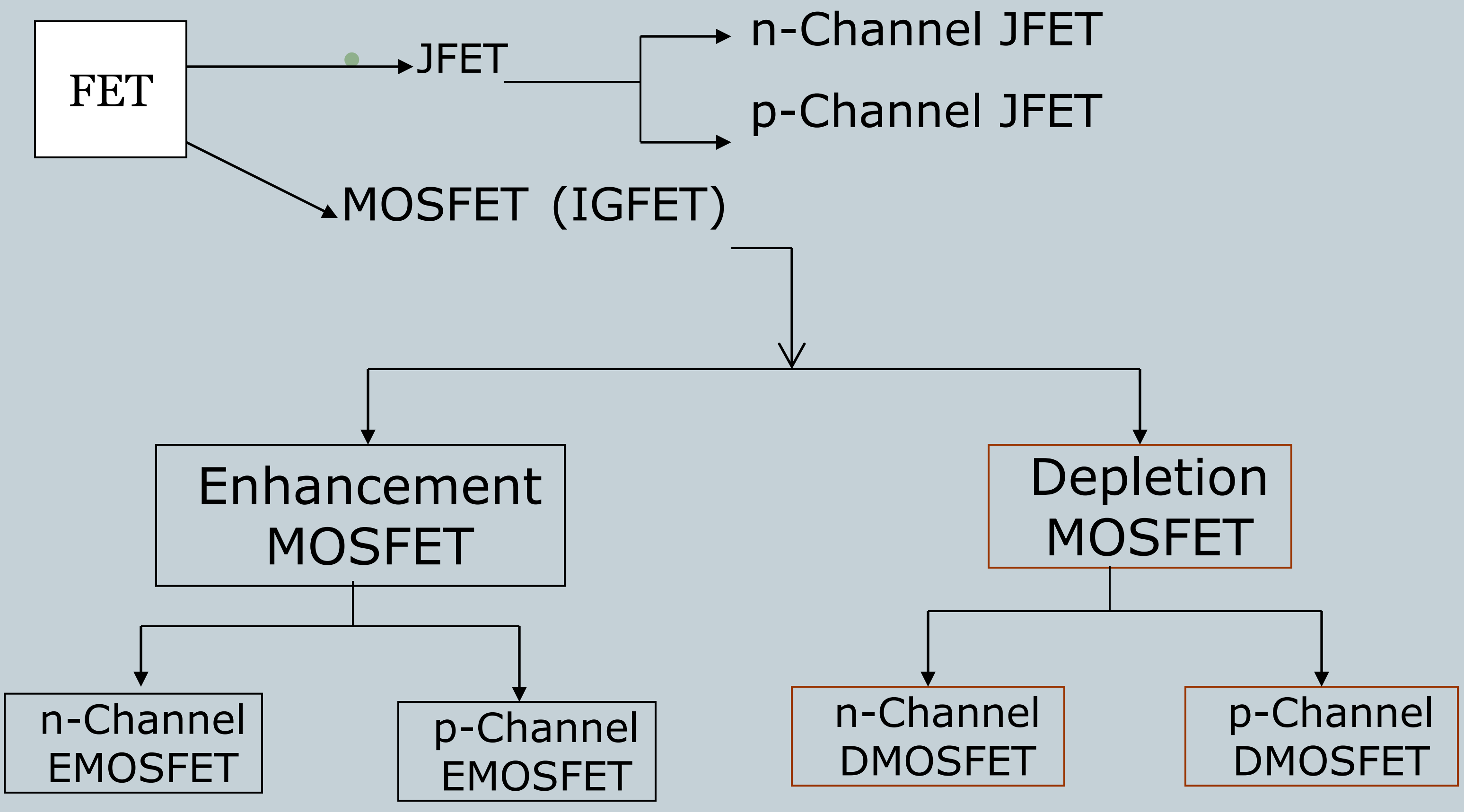
BJT transistors

FET (Field Effect Transistor)

Few important advantages of FET over conventional Transistors

1. Unipolar device i. e. operation depends on only one type of charge carriers (*h* or *e)*
2. Voltage controlled Device (gate voltage controls drain current)
3. Very high input impedance ($\approx 10^9$-10^{12} Ω)
4. Source and drain are interchangeable in most Low-frequency applications
5. Low Voltage Low Current Operation is possible (Low-power consumption)
6. Less Noisy as Compared to BJT
7. No minority carrier storage (Turn off is faster)
8. Self limiting device
9. Very small in size, occupies very small space in ICs
10. Low voltage low current operation is possible in MOSFETS
11. Zero temperature drift of out put is possiblek

Types of Field Effect Transistors (The Classification)



The Junction Field Effect Transistor (JFET)

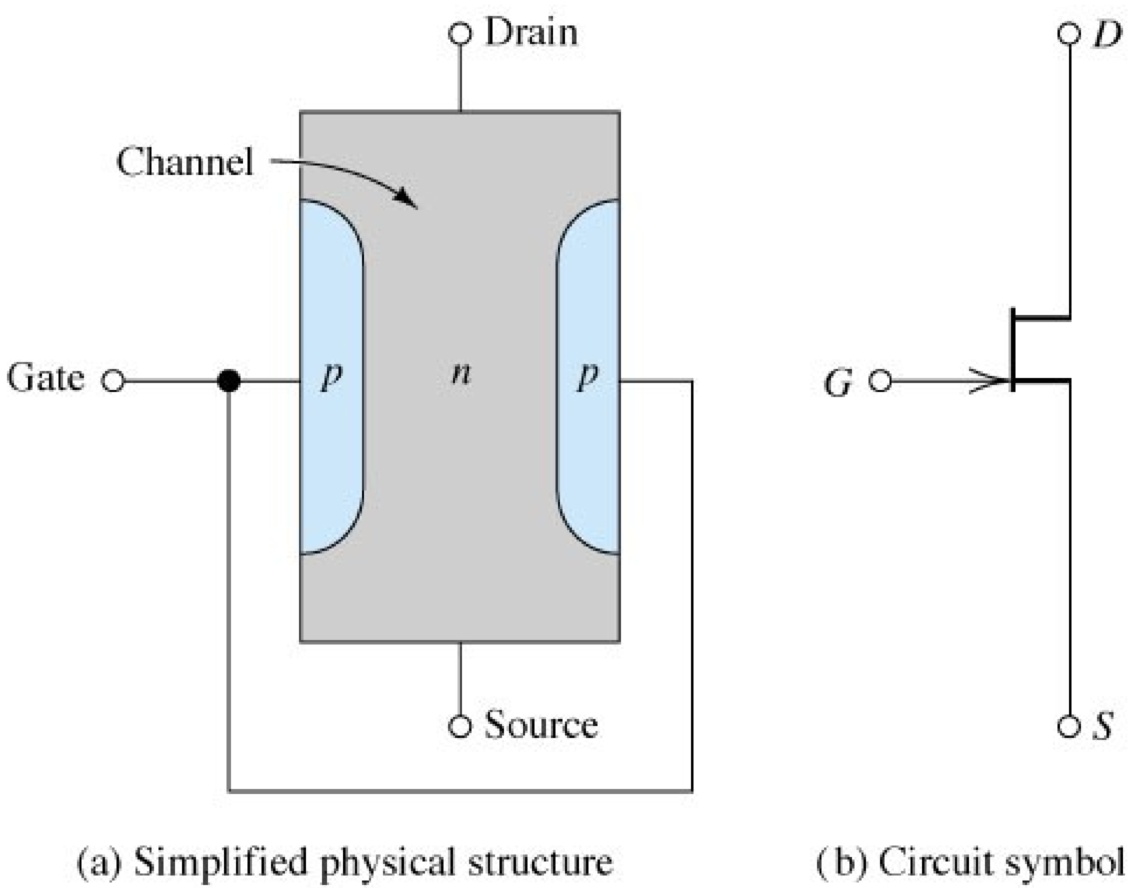
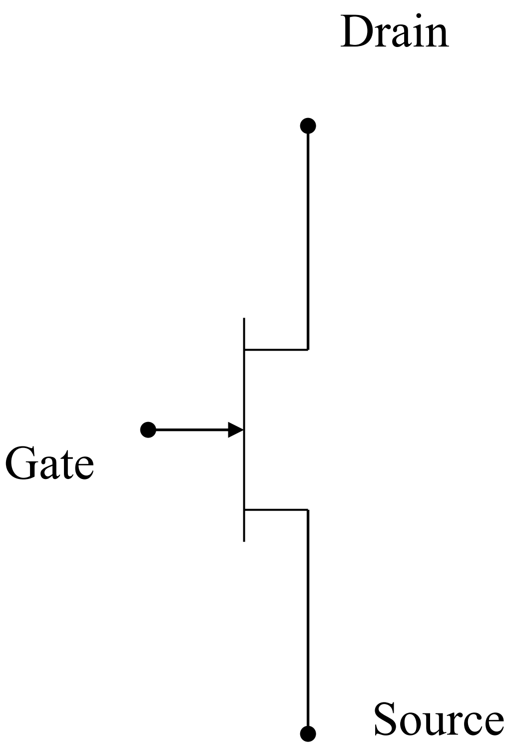
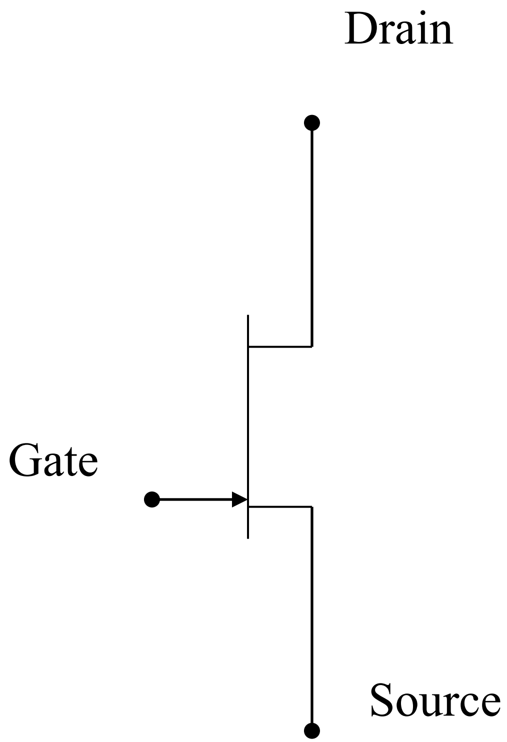


Figure: *n*-Channel JFET.

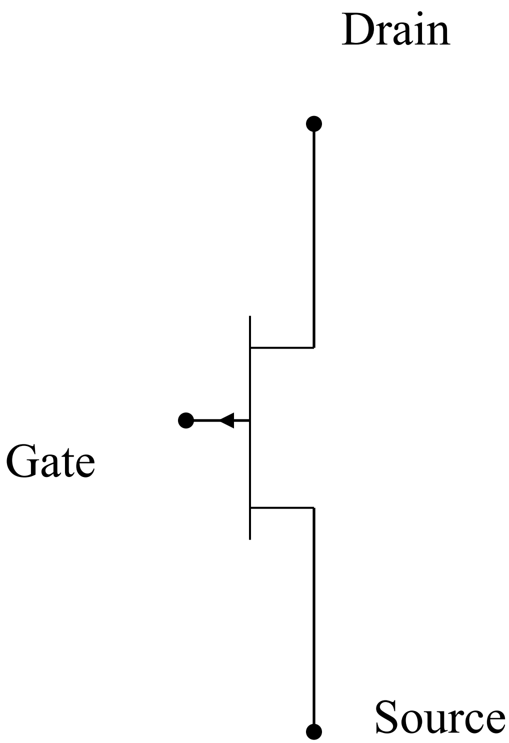
SYMBOLS



n-channel JFET



n-channel JFET
Offset-gate symbol



p-channel JFET

Biasing the JFET

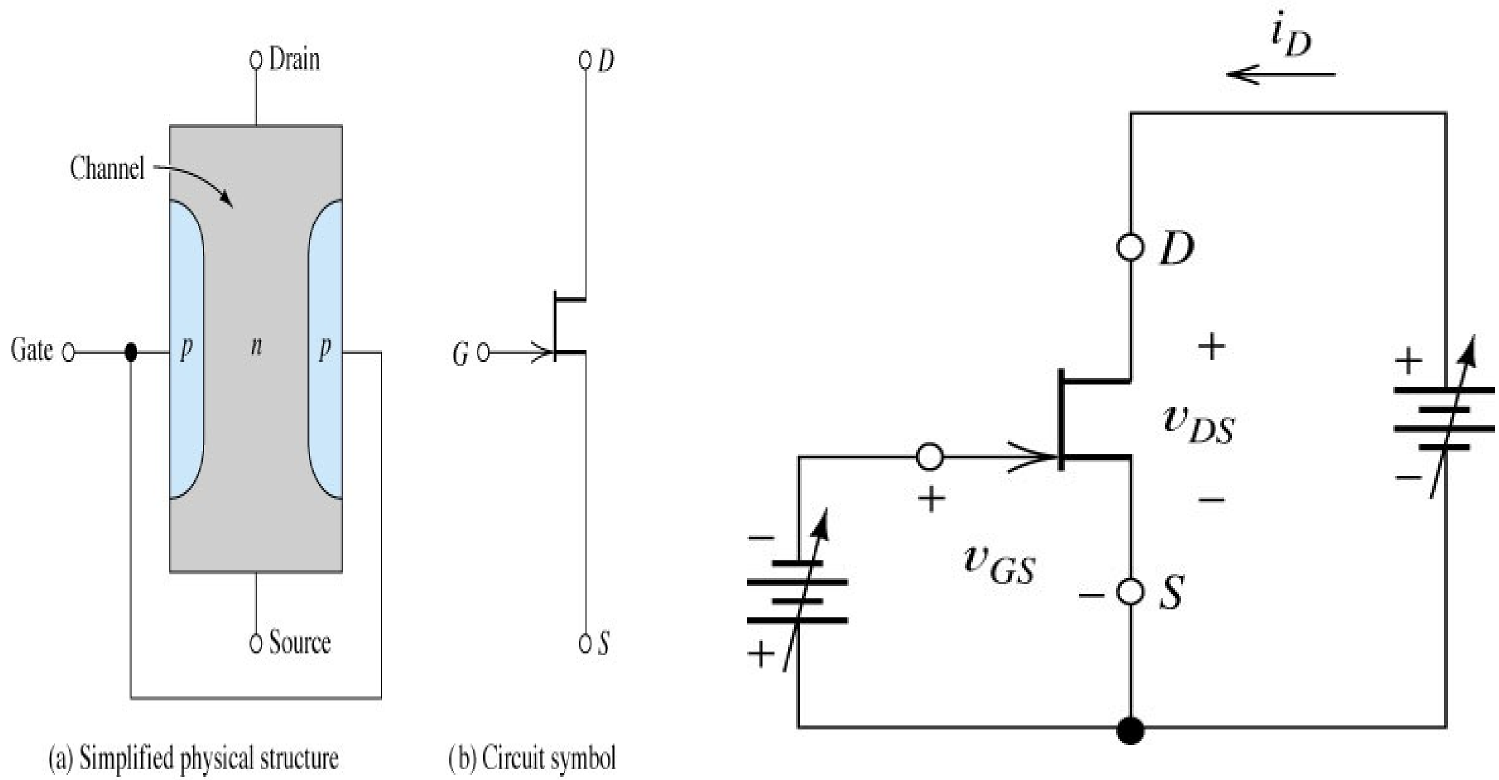


Figure: *n*-Channel JFET and Biasing Circuit.

Operation of JFET at Various Gate Bias Potentials

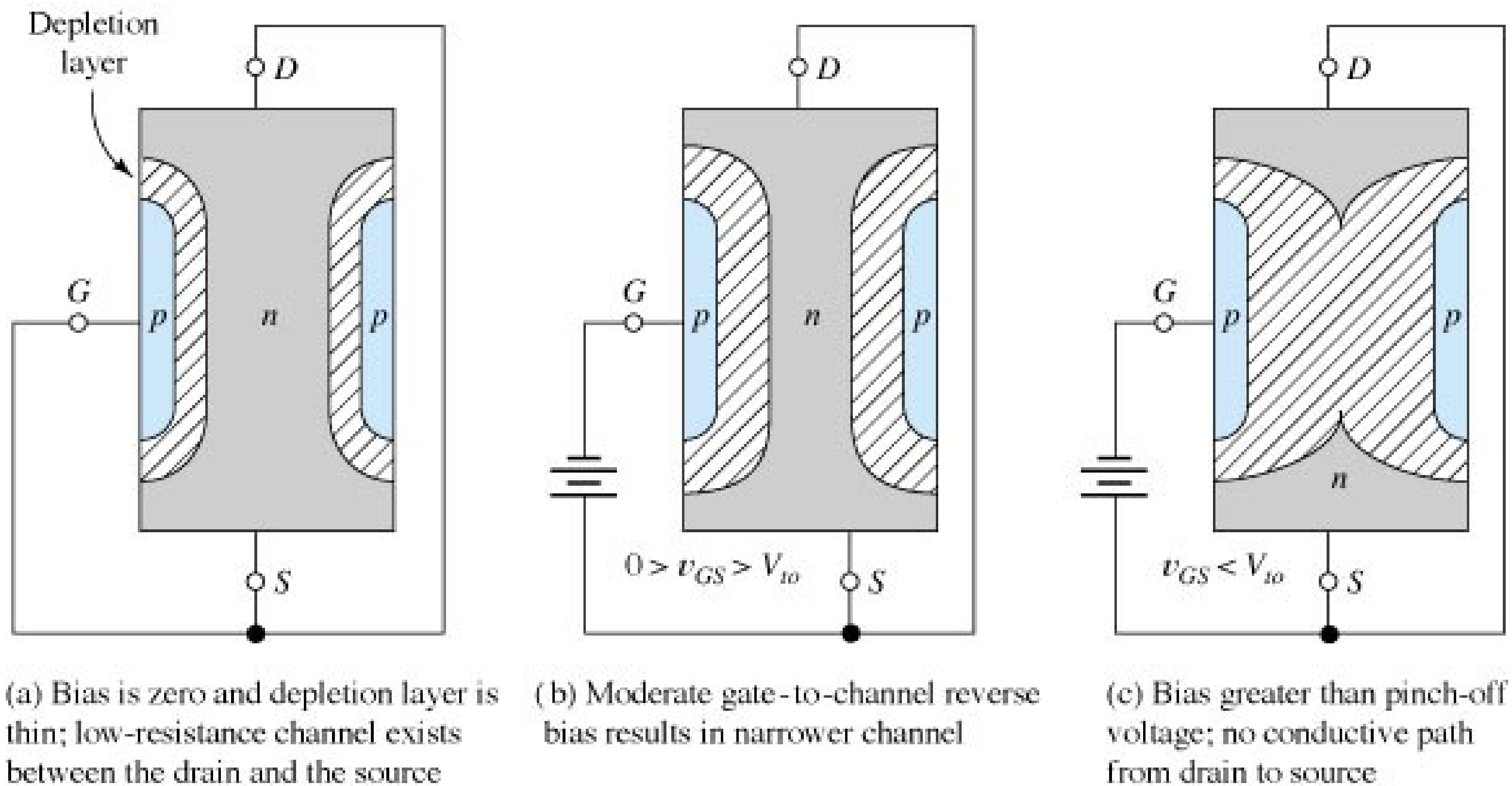
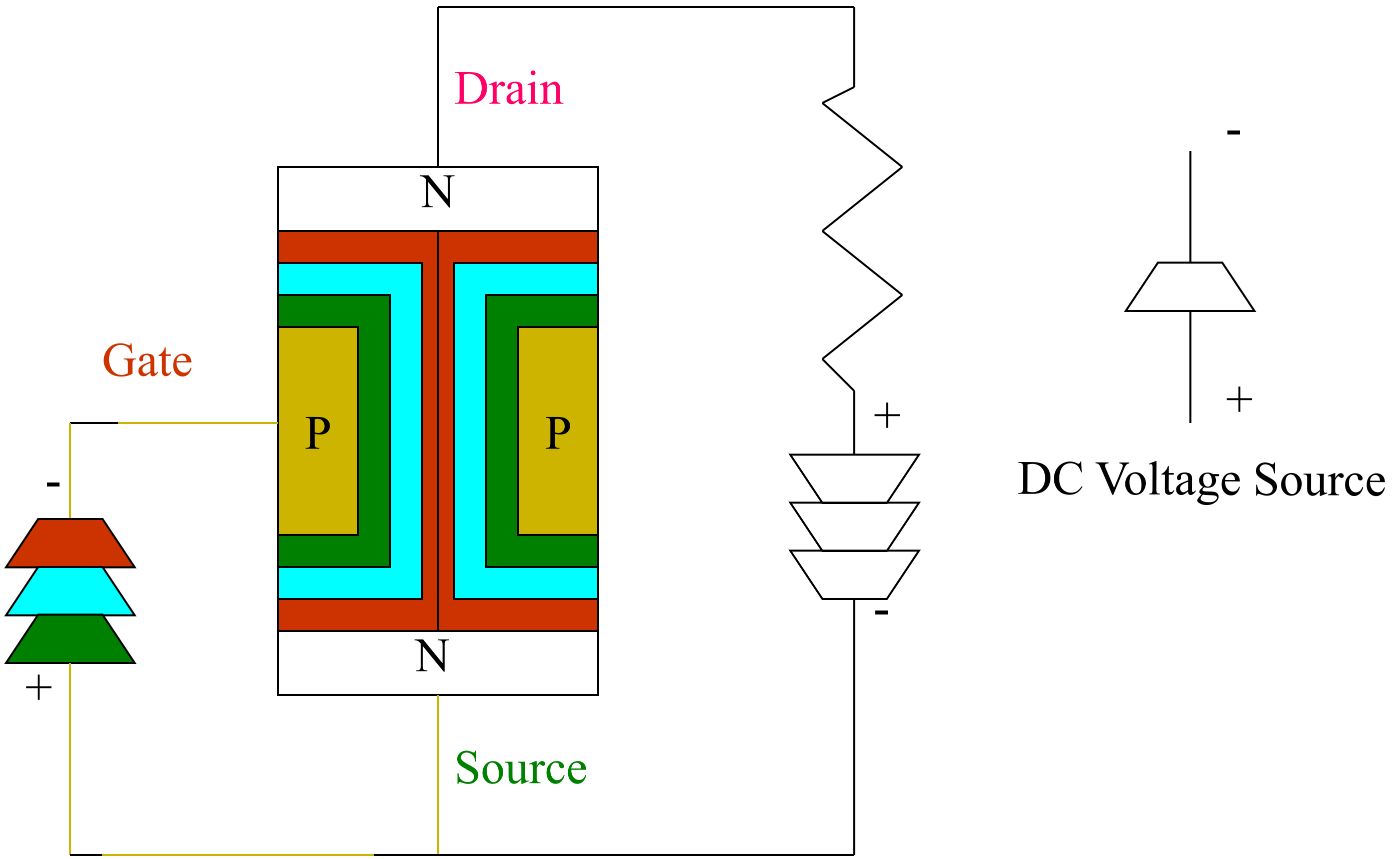
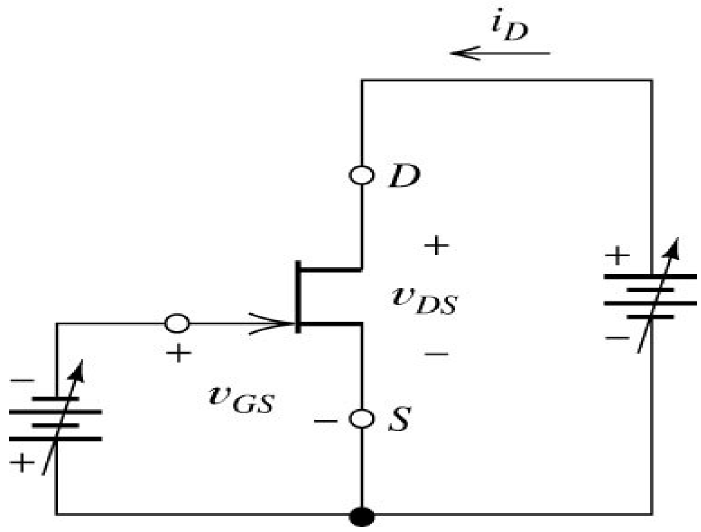


Figure: The nonconductive depletion region becomes broader with increased reverse bias. (*Note:* The two gate regions of each FET are connected to each other.)

Operation of a JFET



Output or Drain (V_D-I_D) Characteristics of n-JFET



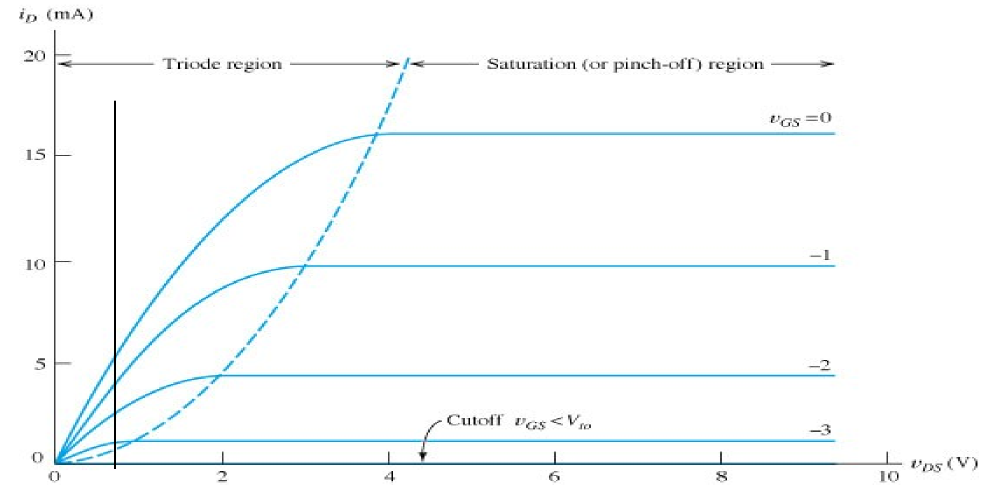


Figure: Circuit for drain characteristics of the *n*-channel JFET and its Drain characteristics.

Non-saturation (Ohmic) Region:

$$V_{DS} < \left(V_{GS} - V_P\right)$$

The drain current is given by

$$I_{DS} = \frac{2I_{DSS}}{V_P^2}\left[\left(V_{GS} - V_P\right)V_{DS} - \frac{V_{DS}^2}{2}\right]$$

Saturation (or Pinchoff) Region:

$$V_{DS} \geq \left(V_{GS} - V_P\right)$$

$$I_{DS} = \frac{I_{DSS}}{V_P^2}\left[\left(V_{GS} - V_P\right)^2\right]$$

and $I_{DS} = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$

Where, I_{DSS} is the short circuit drain current, V_P is the pinch off voltage

Simple Operation and Break down of n-Channel JFET

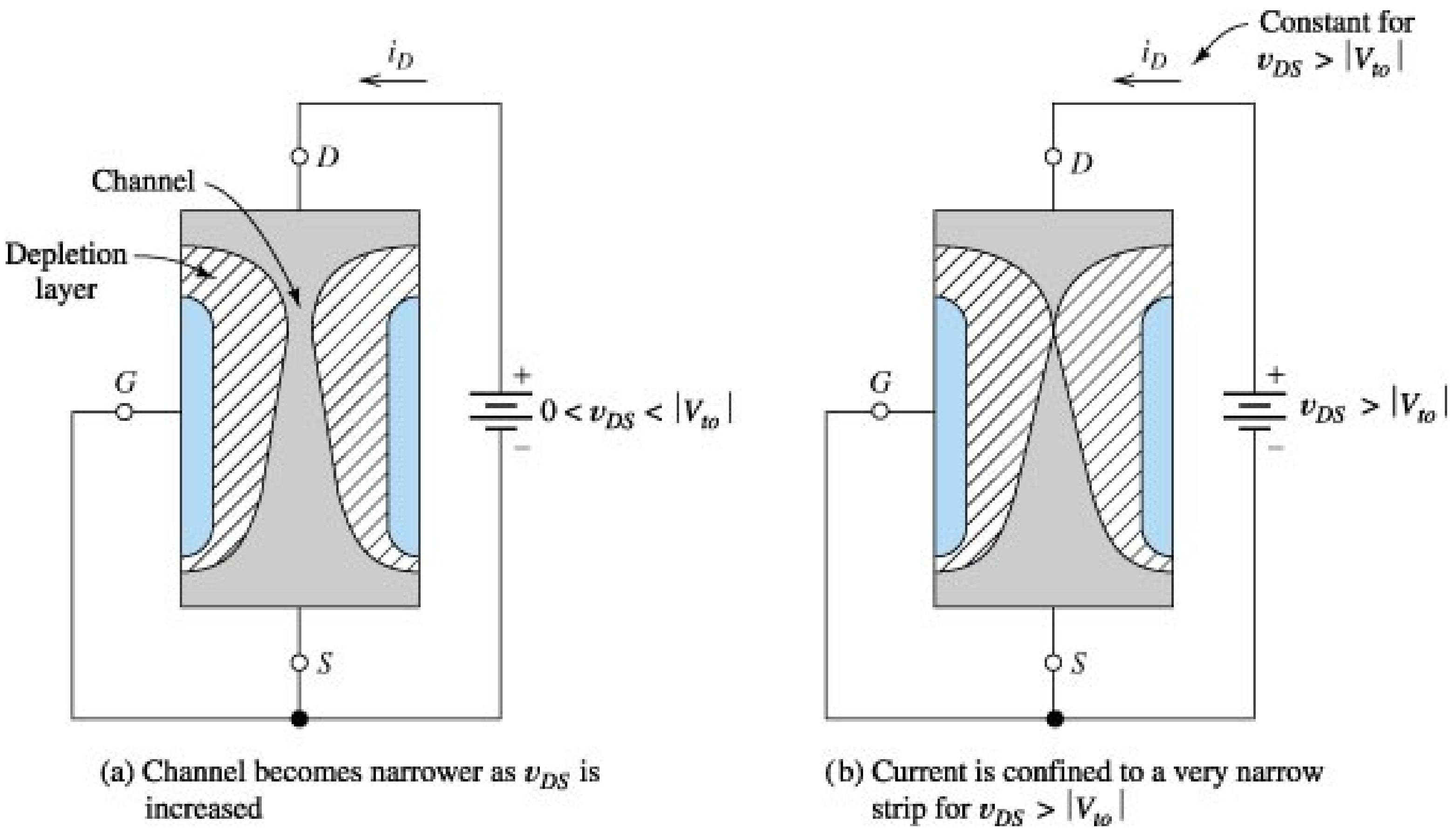
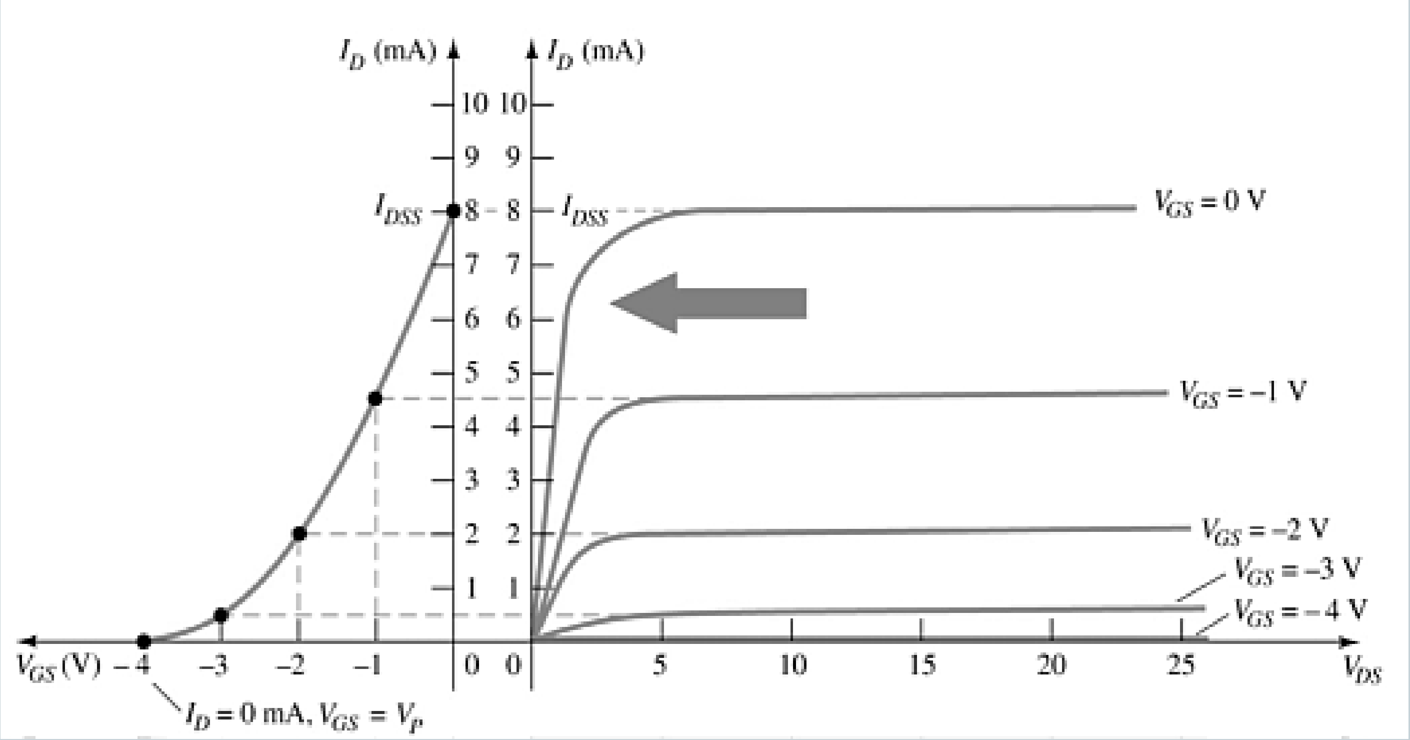


Figure: n-Channel FET for $v_{GS} = 0$.

JFET Transfer Curve

This graph shows the value of I_D for a given value of V_{GS}



Thank You